ITU THEMATIC REVIEWS 2021 (PART 1)

The International Telecommunication Union (ITU) is the United Nations specialized agency for information and communication technologies (ICTs), driving innovation in ICTs together with 193 Member States and a membership of over 900 companies, universities, and international and regional organizations. Established over 150 years ago in 1865, ITU is the intergovernmental body responsible for coordinating the shared global use of the radio spectrum, promoting international cooperation in assigning satellite orbits, improving communication infrastructure in the developing world, and establishing the worldwide standards that foster seamless interconnection of a vast range of communications systems. From broadband networks to cutting-edge wireless technologies, aeronautical and maritime navigation, radio astronomy, oceanographic and satellite-based earth monitoring as well as converging fixed-mobile phone, Internet and broadcasting technologies, ITU is committed to connecting the world. For more information, visit www.itu.int.

RADIO INTERFERENCE

OVERVIEW

- Radio interference is defined by provision No. 1.166 of the ITU Radio Regulations as "the effect of unwanted energy due to one or a combination of emissions, radiations, or inductions upon reception in a radiocommunication system, manifested by any performance degradation, misinterpretation or loss of information which could be extracted in the absence of such unwanted energy".
- Radio interference and its subsequent potential for blocking, jamming, altering the information or degrading the quality of a service can occur for a wide range of reasons, accidental or intentional.
- The consequences can be either short-term (degradation, obstruction or interruptions of a service) or long-term (jeopardizing dependent services or incentives for future investments).
- Radio interference may impact and disrupt broadcasting signals, mobile and fixed communications systems, as well as scientific services which are vital to measure the health of our planet and combat climate change and radionavigation systems used by airplanes, maritime vessels, autonomous cars and any other personal device or telecommunication network relying on time-geolocation information.
- The application of the ITU Radio Regulations is the best instrument to keep interference levels under control and to prevent harmful interference, and the Regulations also contain other corrective measures to be applied, when harmful interference occurs.
- Moreover, these regulatory measures can be complemented with technological solutions for interference mitigation and cancellation.

The following three levels of interference are defined in Article 1 of the RR:

- permissible interference (see No. 1.167);
- acceptable interference (see No. 1.168);
- harmful interference (see No. 1.169).

When interference is harmful

Harmful interference is defined in both No. 1.169 of the RR and in No. 1003 of the ITU Constitution, as"interference which endangers the functioning of a radionavigation service or of other safety services or seriously degrades, obstructs, or repeatedly interrupts a radiocommunication service operating in accordance with Radio Regulations". Harmful interference, the blocking, jamming or degradation of service can take place for a wide range of reasons, which can be either accidental or intentional. Both commercial services as well as critical safety-of-life applications may be degraded and affected.

In general, according to the preamble of the RR (which reproduces No. 197 of Article 45 of the ITU Constitution),"all stations, whatever their purpose, must be established and operated in such a manner as not to cause harmful interference to the radio services or communications of other Members, recognized operating agencies, or other authorized operating agencies which carry on a radio service, and which operate in accordance with the Radio Regulations".

Along these lines, jamming is prohibited by No. 15.1 of the RR, which states that "all stations are forbidden to carry out unnecessary transmissions, or the transmission of superfluous signals, or the transmission of false or misleading signals (...)". Special attention needs to be paid to safety services (aeronautical, maritime and radionavigation), that require absolute international protection. The elimination of harmful interference for these services is imperative, according to No. 15.28 of the RR. Harmful interference can have both short-term consequences (in degradation of service etc.) or long-term effects (jeopardizing dependent services or incentives for future investments).

What can be done

One of ITU-R's main objectives is to ensure interference-free operations of radiocommunication systems by implementing the RR and regional agreements, as well as updating these instruments in an efficient and timely manner through the processes of World and Regional Radiocommunication Conferences.

"It is essential that ITU Member States exercise the utmost goodwill and mutual assistance in the application of the provisions of Article 45 of the Constitution to the settlement of problems of harmful interference". Section VI of Article 15 of the RR sets out the procedure in case of harmful interference, as well as the conditions for the resolution of a problem of harmful interference. The initial procedure is based mainly on a direct approach between the administrations concerned. However, a case of harmful interference may also be communicated to the ITU either for information or with a specific request for assistance, where action on a bilateral basis may have been unsuccessful.

Reporting a case of harmful interference through the national telecommunication regulatory agency to the ITU Radiocommunication Bureau is key to be able to assess the actual situation and to resolve that case but also to prevent its recurrence.

ITU has made efforts to modernize and facilitate the reporting of harmful interference and undertakes capacity-building initiatives to educate and raise awareness about the impact of and possible solutions to harmful interference.

Furthermore, under Article 18 of the RR, any station must be duly licensed by the governments having jurisdiction over the territory where it is intended to operate. The prohibition of jamming equipment lies under the responsibility of ITU Member States and their regulators/enforcement agencies. A growing number of countries have already made it illegal to purchase, sell and/or use GNSS jamming equipment. The Bureau reported this issue to WRC-19 and encouraged Member States to strengthen their control mechanisms at a domestic level.

There is a long-standing practice within ITU-R Study Groups preparing ITU-R Recommendations or standards to ensure compatibility between radiocommunication systems. Reserving a portion of the link budget as a margin (additional energy in the wanted signal being transmitted) to compensate for any interference has worked well for decades to protect against unintentional interference.

ITU'S CONTRIBUTION

ITU assists administrations for resolving cases of harmful interference. When contacted, ITU investigates the causes of the potential harmful interference and forwards to the administrations involved its findings and recommendations for resolving the problem. If this approach proves unsuccessful, the BR then prepares a report for the ITU Radio Regulations Board. Finally, ITU transmits the conclusions of the Board to the administrations concerned, inviting them to take steps and apply ITU's recommendations for eliminating any harmful interference.

ITU also organizes international monitoring programs to identify sources where signal emissions are not in compliance with the RR and to take necessary actions for eliminating unauthorised emissions. The procedure to be followed in cases of harmful interference is regularly highlighted and described in seminars/workshops organised by the ITU, regional organisations, industry and other entities.

ITU organizes regular ITU international satellite symposia to raise awareness of the impact of interference in different domains, presenting solutions from industry as well as regulators. The latest event took place virtually as a webinar in September 2020 and featured experts from NASA, ESA, EUTELSAT, EuroControl and ITU (https://www.itu.int/en/ITU-R/space/workshops/sat-webinars/Pages/default.aspx).

ITU offers an online application, "Satellite Interference Reporting and Resolution System (SIRRS)" (https://www.itu.int/ITU-R/space/sirrs), which assists Member States by facilitating the reporting of harmful interference cases affecting space services. The Radiocommunications Bureau of ITU then investigates the matter and, if requested, provides the necessary assistance to concerned administrations or specially designated stations of the international monitoring system that may be able to help in identifying the source of harmful interference.

Once a source is located, ITU then contacts the administration believed to be responsible for the source of harmful interference to request prompt action to eliminate it. The Bureau can also provide a report to the Radio Regulations Board to help in investigations and options for resolution. In addition, Article 56 of the ITU Constitution sets out a Dispute Resolution Mechanism based on diplomatic channels, and Article 41 of the ITU Convention provides another legal instrument, the Optional Protocol for Compulsory Arbitration.

ITU also uses an International Monitoring System and several Cooperation Agreements signed with Member States, allowing these monitoring facilities to be used to geolocate interference sources.

IN SUMMARY

The ITU Radio Regulations enable the reporting of cases of harmful interference to ITU, technological solutions to mitigate and eliminate interference, and cooperation among Member States, industry and other stakeholders as the vital elements to resolve cases of harmful interference under their control.

Only by doing so, governments and industry can guarantee the required quality and availability of radiocommunications and safety services, to ensure the return of investments and successful space missions so that every citizen of the world can benefit of so many applications in daily life relying on interconnected radiocommunications networks in a transparent manner to end-users.

GEOSPATIAL

OVERVIEW

• Geospatial data describes any data related to or containing information about specific location(s) on the Earth's surface, including 3D information. A geographic information system (GIS) is a framework that provides the ability to capture and analyze spatial and geographic data. Geospatial analysis describes the gathering, display, manipulation and analysis of imagery, Global Positioning System (GPS), satellite imagery and historical data.

• Applications of geospatial analysis include: climate change modelling, weather monitoring and tracking of human and animal population distributions, and planning radiocommunication systems. GIS applications are used to predict, manage and learn about many different phenomena affecting the Earth, its systems and inhabitants.

• The evolution of information and communication technologies (ICTs) and data processing techniques and the availability of higher resolution data have resulted in an explosion in geospatial information and processing.

• There is a growing need for common standards or taxonomies to maximize the use, sharing and analysis of geospatial data. However, changing user requirements, industry changes, and an evolving regulatory and policy environment are all creating new challenges for international cooperation. Who has the right to access such data, and how can we prevent misuse?

OPPORTUNITIES

Geospatial analysis involves the gathering, display, and manipulation of imagery, Global Positioning System (GPS) coordinates, satellite photography and data (real-time or historical), making use of explicit geographic coordinates or identifiers used in geographic models.

Geospatial analysis has advanced considerably in terms of:

1. Greater precision, accuracy and granularity;

2. Easier and faster transmission, analysis and manipulation (e.g. the connectivity of mega-constellations of satellites);

3. The number and type of devices equipped with geospatial and location identification (e.g. different types of devices include the Internet of Things, mobile phones, sensor networks, connected cars, etc.).

For example, fifth-generation mobile technology, IMT-2020 (or 5G), when implemented in the millimetre wave bands, would require very accurate geospatial data and denser telecom networks with significantly higher numbers of base stations than traditional mobile networks. Both accurate geographical data and advanced spatial analytics would be crucial to ensure that these radio networks are cost-effective and efficient. 5G base stations would need to be synchronized to within nanoseconds to improve the positioning accuracy for smart transportation and intelligent traffic management systems [8]/

Geospatial data and information are very valuable, from the global level right down to the local level and can be used for many different use cases, including to monitor, verify and/or confirm:

• Climate modelling and weather prediction; monitoring local weather, seasonal or climatic systems (e.g. the El Ni?o effect);

• Tracking urbanization and the gas emissions and/or pollution from cities and industry;

• Urban use cases, including intelligent transport systems, autonomous vehicles and monitoring traffic congestion in real-time;

• Natural disasters (e.g. extent of landslides or flooding) and relief efforts;

• Identifying and mapping facilities, e.g. schools, clinics, refugee camp size and facilities;

• Monitoring abuse of human rights (e.g. treatment of refugee populations);

• Identifying archaeological sites of interest;

• Mapping deforestation and land use, and estimating crop yields for predicting trends in food and commodity markets;

• Estimating poverty and income levels (e.g. from type of cars or the quality of roof materials);

• Population and animal migrations.

National governments and local authorities need information about a country, the environment, assets, people, and its physical and social infrastructure to inform robust evidence-based decision-making and to encourage economic development, entrepreneurial activity, transparency, or national security.

CHALLENGES

Different concepts, software and taxonomies can give different meanings or interpretations to the same data in creation or storage, creating a need for common standards or taxonomies to maximize the use, sharing and analysis of geospatial data in smart cities, and help scale smart city projects.

However, changing user requirements, industry changes, and an evolving regulatory and policy environment are all creating new challenges for international cooperation. Who has right to access geospatial data, and how can misuse be prevented?

Enabling effective collaboration between the stakeholders responsible for different aspects of geospatial analysis, global or local, is a challenge. Stakeholders may have different interests and incentives. In different domains with different stakeholders, even small differences can make data sharing or exchange difficult or even impossible or result in loss of information or changes to the structure or meaning of the data.

ITU'S CONTRIBUTION

ITU has worked with geospatial information for decades, since it first established the international numbering system for telephony and assigned international codes to countries and territories.

• ITU published the original "International public telecommunication numbering plan", assigning the number structure and functionality for different geographic areas, networks, global services and groups of countries.

• ITU-T Technical Report TR.CLE (06/2020), "Identify call location for emergency services", identifies the call location of fixed and mobile devices for emergency services, helping save time and lives in emergencies.

ITU is working on the regulatory and privacy-related aspects of geospatial information, in relation to mobility of mobile phones or the security aspects of connected cars, for example.

ITU allocates orbital slots, harmonizes and coordinates spectrum management at the international level for global satellite systems using geospatial and radio-meteorological data from ITU membership.

• ITU uses geospatial data and services to:

• Perform accurate technical examinations to ensure operations of radiocommunication systems free of harmful interference;

• Provide software tools (including GIS display) to assist ITU membersin their radio frequency planning activities to comply with the ITU Radio Regulations and Regional Agreements. The ITU Digitized World Map (IDWM[1]) and Subroutine Library represent a database of international geographical data and technical data related to the Radio Regulations and Regional Agreements.

• ITU is currently developing a Geoportal (using the open source technology GeoServer) to store relevant geospatial data and make it accessible to internal and external stakeholders.

ITU has brokered various ICT standards that include the use or transport of geospatial data:

• Recommendation ITU-T Q.3615 (2015), "Protocol for GeoSMS", defines the protocol for 'GeoSMS' which can be used to encode location information.

• Recommendation ITU-T H.460.25 (2010) defines the parameters and method for exchange of geographic information between ITU-T H.323 entities. Geographic information may be either coordinates (i.e., longitude, latitude and altitude) or addresses (e.g., city and street address).

• Recommendation ITU-T L.262/L.94 (2015), "Use of global navigation satellite systems to create a referenced network map", elaborates the guidelines on creation, operation and maintenance of the telecommunication network map by using the Global Navigation Satellite System (GNSS) and geo-referenced systems.

• Recommendation ITU-T F.747.7 (2014), "Requirements for network-based location information conversion for location-based applications and services", enables location information to be accessed and understood by multiple applications and services.

• Recommendation ITU-T F.747.5 (2014), "Requirements and functional architecture of an automatic location identification system for ubiquitous sensor network (USN) applications and services", describes automatic location identification in sensor networks. The automatic location identification (ALI) capability enables a device to discover its own location in various networks such as a mobile network, the Internet, or a low-power wireless network.

ITU also provides information to its Member States using various maps:

• SMS4DC, the Spectrum Management System for Developing Countries, uses maps for displaying terrain data.

• Digital Terrestrial Television transition (DSO database).

• The Interactive Transmission Maps display the transmission lines, nodes and satellite earth stations and also the broadband map.

• Project implementation (ICTs for sustainable development) at the regional and national levels, e.g. GIGA,PRIDA, and FIGI.

• ITU's Transmission Maps display transmission lines, nodes and satellite earth stations, as well as access to digital financial services[2].

• ITU has developed an ArcGIS StoryMap for the Global E-waste Monitor 2020, which includes interactive maps with spatial data [3].

ITU also collaborates with external stakeholders on various issues to do with geospatial data, including with the UN Geospatial Network, WGIC and OGC.

SMART SUSTAINABLE CITIES

OVERVIEW

• More than half of the world's people live in cities today. By 2050, nearly seven in ten people will be living in cities. Cities account for more than 70 per cent of global carbon emissions and 60 to 80 per cent of energy consumption. Rapid urbanization has created additional challenges such as social inequality, traffic congestion and water contamination and its associated health issues.

• Governments and municipalities can use information and communication technologies (ICTs) and other technologies to build smarter and more sustainable cities for their citizens. A smart sustainable city is an innovative city that uses ICTs to improve quality of life, the efficiency of urban operations and services and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social, environmental and cultural aspects [1]

• Although cities where all urban systems and services are connected do not exist as of yet, many cities are already on the path to becoming smart sustainable cities. They rely on ICTs, for example, to enhance energy efficiency and waste management, improve housing and health care, optimize traffic flow and safety, detect air quality, alert police of crimes occurring on the streets and improve water and sanitation systems.

• ICTs have the potential to accelerate the achievement of all 17 United Nations Sustainable Development Goals (SDGs), including SDG 11, which aims to achieve sustainable cities and communities.

CHALLENGES AND SOLUTIONS

Smart sustainable cities need a telecommunication infrastructure that is stable [2] , secure [3], reliable [4] and interoperable [5] to support an enormous volume of ICT-based applications and services.

Recent developments in the Internet of Things (IoT), Artificial Intelligence (AI) and smart grids and meters are driving and supporting the development of smart sustainable cities throughout the world.

IoT-referring to the network of rapidly growing computing devices with built-in sensors and software to connect with each other and share data-enables billions of devices and objects equipped with smart sensors to connect with each other, collect real-time information and send this data, via wireless communication, to centralized control systems. These, in turn, manage traffic, reduce energy usage and improve a wide range of urban operations and services.

AI allows extremely large data sets to be analysed computationally to reveal patterns, which are used to inform and enhance municipal decision-making.

Smart grids-referring to electricity supply networks that use digital communication technology to detect and react to local changes in usage-help to optimize energy use in cities. Smart meters and sensors, equipped with Internet Protocol addresses, can communicate information about the end-users? energy use to the energy supplier, giving end-users more control over their consumption.

While 3G and 4G networks used by mobile phones today pose a number of problems in supporting the range of services required for smart sustainable cities applications, the development of 5G, referring to the fifth generation of mobile technologies, has the potential to reliably connect devices to the Internet and other devices, transport data much more quickly and process a high volume of data with minimal delay.

ITU'S CONTRIBUTION TO SMART SUSTAINABLE CITIES

ITU is working to improve the reliability, security and interoperability of ICT infrastructure needed for smart sustainable cities, while at the same time advocating for the use of ICTs to reduce the consumption of energy and enhance services and quality of life for city dwellers.

Setting standards

ITU and members within the ITU-T Study Group 20, which is dedicated to IoTs, smart cities and communities, have been developing international standards that establish technical criteria, processes and practices to enable a coordinated development of IoT technologies for smart sustainable cities. Most recently, the study group has been working on topics including AI, blockchain, machine-to-machine communication and Big Data aspects of IoT.

ITU and members within the ITU Focus Group on Data Processing and Management are working on the development of international standards that allow the IoT ecosystem to be fully inclusive, interoperable and capable of making full use of the data generated by the devices feeding into the system. This is to mitigate the risk of data ?silos? emerging in different industry sectors.

ITU has also recently developed standards ensuring the security of networks in urban areas.

ITU's work on standards for 5G systems, which will help make smart sustainable cities a reality, is also underway.

ITU standards outline how smart grids can help build more controllable and efficient energy systems.

The ITU Focus Group on Smart Sustainable Cities has identified standardized frameworks needed to support the integration of ICT services in smart cities and key trends in urban smart water management.

Global collaboration and advocacy

In 2016, ITU and the United Nations Economic Commission for Europe (UNECE) launched the global platform "United for Smart Sustainable Cities " (U4SSC) to advocate for public policy and to encourage the use of ICTs to facilitate and ease the transition to smart sustainable cities. The platform is now supported by 14 other United Nations bodies. The U4SSC has developed a set of key performance indicators (KPIs) for s mart sustainable cities, allowing cities to set goals, collect data and measure progress in five major areas: the use of ICTs; physical infrastructure; social inclusion and equity of access to services; quality of life; and environmental sustainability. More than 50 cities worldwide, including Bizerte, Dubai, Kairouan, Maldonado, Manizales, Montevideo, Moscow, Pully, Rimini, Singapore, Valencia and Wuxi, are already implementing these KPIs.

Below are just a few examples showing how ICTs are helping to build smart sustainable cities:

- In Singapore , sensors and cameras build on the city state?s existing digital system and enable the government to assess the performance and efficiency of traffic flow and identify problems such as potholes and bumpy bus rides as well as lawbreakers. For example, to strengthen security in public spaces, the city has installed more than 62,000 police cameras in public housing blocks and carparks.
- Copenhagen, Denmark, has upgraded its street lights with efficient lamps connected by a wireless network. Smart street lights save costs because they can be programmed to dim or brighten automatically, optimizing the use of energy while lowering the risk of crime and traffic accidents.
- So Paulo, Brazil, has developed a solution to estimate and predict air quality using AI and Big Data analytics. Aggregated, anonymized data is leveraged from the mobile network and layered with data from weather, traffic and pollution sensors. This helps calculate pollution levels 24 to 48 hours in advance, helping policy-makers, municipalities and governments to take action to prevent death and disease-for example, by redirecting traffic before air pollution hotspots strike.
- In Holon municipality in Israel, the sewage system was plagued with problems such as frequent blockages and overflows. The municipality installed devices equipped with sensors to better manage its sewer systems and send alerts via short message service (SMS) when the level reaches low or high limits.
- Dubai introduced an eComplaints system for citizens to regularly provide feedback on public services.

SATELLITE ISSUES:
EARTH STATIONS IN MOTION (ESIM)

OVERVIEW

• Earth stations in motion (ESIM) address a complex challenge - how to provide reliable and high-bandwidth Internet services to what are - literally - moving targets. They provide broadband communications, including Internet connectivity, on platforms in motion. There are currently three types of ESIMs: ESIM on board aircraft (aeronautical ESIM), ESIM on board ships (maritime ESIM) and ESIM on board land vehicles (land ESIM).

• Advances in satellite manufacturing and earth station technology have made ESIM more widespread and more practical. When ships are at sea or aircrafts cross the oceans, they are out of reach of terrestrial networks. ESIM systems can provide continuous and consistent service with very wide, or literally global, geographic coverage as ships and aircraft operate at or over almost any location.

• The demand for spectrum for ESIM is increasing. For example, in 2014, over 20 000 vessels were connected via satellite. This number is expected to increase to around 50 000 vessels over the next few years.

• The typical data rates currently provided by terminals operating in networks serving ESIM are around 100 Mbit/s - much higher, or faster, than those provided historically by satellite networks and systems in the mobile-satellite service (MSS), which use lower frequency bands (e.g. the 1.5 GHz, 1.6 GHz, 2.1 GHz, and 2.4 GHz bands).

• To address the increasing need of ESIM for radio-frequency spectrum, while protecting other and existing services, the ITU World Radiocommunication Conference (WRC-19), which took place in Sharm el-Sheikh, Egypt, from 28 October to 22 November 2019, decided on the regulatory and technical conditions under which the frequency bands 17.7 19.7 GHz (space-to-Earth) and 27.5-29.5 GHz (Earth-to-space) can be used by the three types of ESIMs communicating with geostationary (GSO) space stations in the fixed-satellite service (FSS).

• ESIM contribute, to Sustainable Development Goal 9 (industry, innovation and infrastructure) by connecting ships, aircraft and land vehicles and ensuring their safety and security and and that of their passengers, cargo and systems. When information and communication infrastructure is down in natural disasters, land ESIM can be vital.

CHALLENGES AND SOLUTIONS

Earth stations in motion (ESIM) are earth stations that communicate with geostationary-satellite orbit (GSO) systems operating in the fixed-satellite service (FSS) and operate on platforms in motion in the frequency ranges 17.7-20.2 GHz (space-to-Earth) and 27.5-30 GHz (Earth-to-space).

Historically, communication services to mobile platforms were usually provided by satellite systems in the mobile-satellite service (MSS) using relatively low frequency bands (e.g.- the 1.5 GHz, 1.6 GHz, 2.1 GHz, and 2.4 GHz bands). The frequency bandwidths available to individual users in these ranges are relatively low - typically a few kHz to a few hundred kHz. The narrow frequency bandwidths available limit the data rates that can be achieved, which range from a few kbit/s to around 700 kbit/s in a single channel.

The typical data rates currently provided by terminals operating in networks serving ESIM are around 100 Mbit/s. Data rates may increase to support higher broadband demand or be reduced for applications using smaller earth station antennas while still supporting much higher data rates than are available over existing MSS systems. ITU studies examine how to deliver higher data rates, without impacting other and existing services adversely.

When ships are at sea or aircraft cross the oceans, they are out of reach of terrestrial networks. For such crafts on or over vast oceans, an ESIM system can resolve this challenge by providing continuous broadband connectivity for crew and passengers.

ESIM provide broadband communications on cruise ships, the largest of which can accommodate several thousands of passengers. In addition, ESIM stations can provide broadband communications for managing ship operations, such as for transmission of engine diagnostics, as well as for access to the corporate network and for crew communications. The number of maritime vessels with a broadband connection by satellite grew by almost 25% between 2012 and 2013. In 2014, over 20 000 vessels were satellite connected and this number is expected to increase to around 50 000 vessels over the next few years. This strong growth has created greater demand for spectrum for ESIM.

In addition, ESIM meet the broadband connectivity requirements of land vehicles, including trains, coaches, vans, trucks and motorhomes. Land ESIM can provide connectivity throughout countries and are particularly useful in areas without coverage by terrestrial networks.

ESIM applications also exist for government users and aid organizations that have broadband communication needs for land vehicles, ships and aircraft. For example, when information and communication infrastructure is down in natural disasters, land ESIM can be vital.

ITU'S CONTRIBUTION

ITU Member States agreed at the WRC-19 in Sharm el-Sheikh, Egypt to a new Resolution that will boost the deployment of ESIM.

To address the increasing need for radio-frequency spectrum for ESIM, while protecting other services, WRC-19 agreed decided on the regulatory and technical conditions under which the frequency bands 17.7 19.7 GHz (space-to-Earth) and 27.5-29.5 GHz (Earth-to-space) can be used by the three types of ESIM communicating with geostationary (GSO) space stations in the fixed-satellite service (FSS).

The new Resolution starts by stating that "there is a need for global broadband mobile-satellite communications, and that some of this need could be met by allowing earth stations in motion (ESIMs) to communicate with space stations of the geostationary-satellite orbit (GSO) fixed-satellite service (FSS) operating in the frequency bands 17.7-19.7 GHz (space-to-Earth) and 27.5-29.5 GHz (Earth-to-space)."

However, the Resolution also cautions that the frequency bands 17.7-19.7 GHz (space-to-Earth) and 27.5-29.5 GHz (Earth-to-space) "are also allocated to terrestrial and space services used by a variety of different systems, and these existing services and their future development need to be protected, without the imposition of undue constraints, from the operation of ESIMs."

Considering the above, the Resolution lays out technical, operational and regulatory conditions for any ESIM communicating with a GSO FSS space station in the frequency bands 17.7-19.7 GHz and 27.5-29.5 GHz, or parts thereof.

WRC-19 also decided to continue studies on this issue for the next WRC scheduled in 2023, where the use of the frequency bands 17.7-18.6 GHz, 18.8-19.3 GHz and 19.7-20.2 GHz (space-to-Earth) and 27.5-29.1 GHz and 29.5-30 GHz (Earth-to-space) by ESIM communicating with non-geostationary satellites in the fixed-satellite service will be addressed together with a potential additional 500 MHz of new spectrum being identified for ESIM communicating with geostationary satellites in the fixed-satellite service in the frequency band 12.75-13.25 GHz (Earth-to-space).

NON-GEOSTATIONARY SATELLITE SYSTEMS

OVERVIEW

• National governments, companies and international institutions have all acknowledged the importance of bridging the digital divide to foster economic growth, drive social inclusion and meet consumer demand. However, billions of people still do not have access to broadband internet, particularly those living in rural or remote areas.

• Satellite systems offer significant advantages for expanding broadband coverage: they provide instant-on coverage across wide geographies without regard to challenging topography; they are reliable and largely immune to many risks that other networks face, including accidental damage, theft, conflict areas and natural disasters.

• The rapidly increasing use of non-geostationary satellite orbits (non-GSO), such as medium Earth orbits (MEO) and low Earth orbits (LEO), represents an important innovation in satellite technology - and a potential breakthrough in connecting the unconnected so that they, too, can reap the benefits of today's digital economy. Satellite connectivity is also important for the aviation and maritime sectors that operate aircraft and vessels that can be out of reach of terrestrial networks during their journeys.

• The ITU Radio Regulations (RR) enable the introduction of new applications of radiocommunication technology while ensuring the efficient use of radio-frequency spectrum, i.e. the operation of as many systems as possible, without interference.

• Space-based connectivity is helping make smart societies a reality across all 17 Sustainable Development Goals (including intelligent transport systems, e-government, tele-education, e-health, e-logistics, smart energy, smart agriculture), in both developed and developing countries, and particularly in rural and remote areas.

CHALLENGES AND SOLUTIONS

• Providing terrestrial connectivity is difficult in rural or remote areas, not only due to terrain and their isolation, but also because the cost of providing service via terrestrial mobile networks yields a poor return on investment for sparsely populated areas as compared to urban areas.

• New advances in satellite technologies could help bridge the digital divide more rapidly - and at lower cost - than ever before.

• Geostationary (GSO) satellites are at 36 000 kilometres above the Earth, a place where they appear fixed in the sky when observed from the ground. Non-GSO satellites at medium Earth orbits (MEO) altitudes are between 8 000 and 20 000 kilometres above the Earth and low Earth orbits (LEO) altitudes are between 400 to 2 000 kilometres above the Earth. Since non-GSO satellites move across the sky during their orbit around the Earth, non-GSO operators must deploy a fleet of satellites, generally called "constellations", to provide continuous service from these altitudes.

• Advances in satellite design, manufacturing and launch service capabilities have enabled the design and deployment of non-GSO fixed-satellite service (FSS) constellations. Additionally, the advances in antenna and terminal technology have enabled the usage of the 50/40 GHz frequency bands for both GSO FSS networks and non-GSO FSS systems.

• Constellations intend to cover the globe providing high-bandwidth connectivity, processing very high volumes of data with minimal delay. This could enable the fifth generation of mobile technologies (IMT-2020/5G) and theInternet of Things - a network of things to connect with each other and share data - which in turn help build smart societies.

• There is a need to encourage the development and implementation of new technologies in the FSS at frequencies above 30 GHz. The FSS systems based on the use of new technologies above 30 GHz and associated with both GSO and non-GSO satellite constellations can provide high-capacity and low-cost means of communication even to the most isolated regions of the world.

• The ITU Radio Regulations (RR) should enable the introduction of new applications of radiocommunication technology while ensuring the efficient use of radio-frequency spectrum, i.e. the operation of as many systems as possible, without interference. The RR include provisions that allow GSO networks and non-GSO systems to operate without creating harmful radio interference to each other.

ITU'S CONTRIBUTION

ITU Member States at the World Radiocommunication Conference (WRC-19) in Sharm el-Sheikh, Egypt, adopted an innovative new milestone-based approach for the deployment of non-geostationary satellite (non-GSO) systems in specific radio-frequency bands and services.

The agreement reached at WRC-19 established regulatory procedures for the deployment of non-GSO systems, including mega-constellations in low-Earth orbit.

Under the newly adopted regulatory regime, these systems will have to deploy 10% of their constellation within 2 years after the end of the current regulatory period for bringing into use, 50% within 5 years and complete the deployment within 7 years.

The milestone-based approach will provide a regulatory mechanism to help ensure that the Master International Frequency Register (MIFR) reasonably reflects the actual deployment of such non-GSO satellite systems in specific radio-frequency bands and services.

This agreement strikes a balance between the prevention of radio-frequency spectrum warehousing, the proper functioning of coordination, notification and registration of frequency assignments in the MIFR and the operational requirements related to the deployment of non-GSO systems.

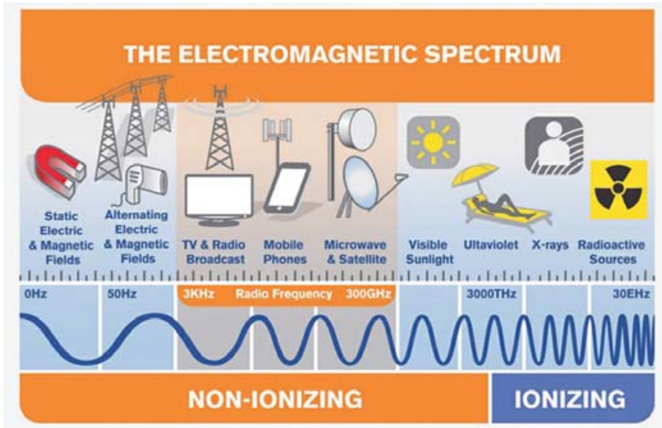
Filings for frequency assignments to non-GSO satellite systems composed of hundreds to thousands of satellites have been received by ITU since 2011, in frequency bands allocated to the fixed-satellite service (FSS) or the mobile-satellite service (MSS).

The Conference also specifically called for further studies by ITU-R on tolerances for certain orbital characteristics of non-GSO space stations of the fixed-satellite, mobile-satellite, and broadcasting-satellite services to account for potential differences between the notified and deployed orbital characteristics, as well as for the possible development of non-GSO post-milestone procedures.

5G, HUMAN EXPOSURE TO ELECTROMAGNETIC FIELDS (EMF) AND HEALTH

OVERVIEW

- 5G – the 5th generation of mobile technologies - is an evolution from the previous generations of mobile technology: 2G, 3G and 4G.
- 3G, 4G and 5G networks produce radio-frequency electromagnetic fields which are used to transmit information.
- Despite extensive studies into the health effects of mobile phones and base stations over the last two or three decades, there is no indication of an increased health risk when exposed to electromagnetic fields below the levels specified by international bodies.
- For all radio frequencies (0 to 300 GHz), international maximum levels are designed to avoid any adverse health effects.
- ITU does not set maximum levels of exposure of the public to electromagnetic fields. These levels are set by competent bodies and ITU in turn references their standards and recommendations in its relevant ITU Recommendations.
- Countries (ITU Member States) are sovereign and set their own national standards for exposure to electromagnetic fields. Most countries draw on the ITU Recommendations.



Mobile, or wireless, technologies – mobile phones, tablets and other wireless devices – have become basic communication tools of everyday life. They enable billions of people around the world to listen to the radio in their cars, watch free-to-air television programmes at home, travel safely in cities and around the globe and stay connected. For many on this planet, mobile is the primary - sometimes only - channel for accessing the Internet and the benefits it brings.

5G - the 5th generation of mobile technologies - is an evolution from the previous generations of mobile technology: 2G, 3G and 4G. 4G systems, for example, have opened a new era for mobile Internet, enabling many apps-based businesses used for such services as m-Learning, m-Health and mobile money.

5G, referred to by ITU as IMT-2020, is seen as opening yet another new era, supporting applications such as smart homes and buildings, smarter and cleaner cities, self-driving cars and road safety, other intelligent transport systems, 3D video, work and play in the cloud, remote medical services, virtual and augmented reality, and massive machine-to-machine communications for industry automation and manufacturing. 3G and 4G networks currently face challenges in supporting these services.

Mobile technologies and human health

Together with the introduction of mobile communication technologies, there has been some public concern about the potential health risks associated with the use of mobile phones and living near base stations.

3G, 4G and 5G networks produce radio-frequency electromagnetic fields which are used to transmit information. Electromagnetic fields have been around in different forms since the birth of the universe. They differ from each other by frequency and visible light is its most familiar form.

For all radio frequencies (0 to 300 GHz), international maximum levels are designed to avoid any adverse health effects.

Despite extensive studies into the health effects of mobile phones over the last two or three decades, there is no indication of an increased health risk when exposed to electromagnetic fields below the levels specified by international bodies.

There is no evidence that electromagnetic fields from existing (2G, 3G and 4G) mobile networks pose any health risks, provided that administrations enforce the exposure limits established by international bodies.

There is no scientific basis of any relation between the transmission of the coronavirus and 4G or 5G or any other electromagnetic waves.

Who regulates the exposure to EMF?

ITU does not set maximum levels of exposure of the public to electromagnetic fields. These levels are set by competent bodies and ITU in turn references their standards and recommendations in its relevant ITU Recommendations.

Countries (ITU Member States) are sovereign and set their own national standards for exposure to electromagnetic fields. Most countries draw on the ITU Recommendations.

Two main bodies have issued radio frequency exposure guidelines:

• The International Commission on Non-Ionizing Radiation Protection (ICNIRP): see https://www.icnirp.org, and

• The Institute of Electrical and Electronics Engineers (IEEE): see https://standards.ieee.org/standard/C95_1-2019.html

ITU'S CONTRIBUTION

ITU's mandate is to allocate the global radio spectrum and satellite orbit resources, to develop the technical standards that ensure networks and technologies seamlessly interconnect, are secure and improve access to ICTs to underserved communities worldwide.

ITU maintains the international treaty on the use of the radio-frequency spectrum (bands of radio frequencies) and satellite orbits that provides for a wide variety of wireless services on a harmonized basis. This avoids the possibility of harmful interference, ensures interoperability and reduces the cost of services and devices through the resulting economies of scale. The treaty provides for all generations of mobile technologies, from 2G to 5G and beyond.

ITU Recommendations refer to the standards, guidelines and recommendations on the maximum levels for exposure to EMF, which are established by competent international bodies [1] [2].

ITU publishes an EMF Guide and app in ITU's 6 official languages.

ITU provides recommendations on the means for measuring and monitoring electromagnetic fields and mitigating exposure [3] [4] [5] [6] [7].

REFERENCES

[1] Recommendation ITU-T K.91 "Guidance for assessment, evaluation and monitoring of human exposure to radio frequency electromagnetic fields"

[2] Recommendation ITU-T K.91 Supplement 1 "Guide on electromagnetic fields and health"

[3] Recommendation ITU-T K.61, "Guidance on measurement and numerical prediction of electromagnetic fields for compliance with human exposure limits for telecommunication installations"

[4] Recommendation ITU-T K.52, "Recommendation ITU-T K.52 (2018), Guidance on complying with limits for human exposure to electromagnetic fields"

[5] Recommendation ITU-T K.70, "Recommendation ITU-T K.70 (2018), Mitigation techniques to limit human exposure to EMFs in the vicinity of radiocommunication stations"

[6] Recommendation ITU-T K.100, "Recommendation ITU-T K.100 (2018), Measurement of radio frequency electromagnetic fields to determine compliance with human exposure limits when a base station is put into service"

[7] Recommendation ITU-R BS.1698, "Recommendation ITU-R BS.1698 (2005), Evaluating fields from terrestrial broadcasting transmitting systems operating in any frequency band for assessing exposure to non-ionizing radiation";

[8] https://www.itu.int/en/publications/ITU-R/Pages/publications.aspx?parent=R-SOFT-IDWM-2010&media=electronic

[9] ICT infrastructure for Financial inclusion is available at https://www.itu.int/en/myitu/News/2020/10/06/07/37/Mapping-financial-inclusion-Mexico-FIGI

[10] https://www.itu.int/en/ITU-D/Environment/Pages/Toolbox/Country-Story-Maps.aspx